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BITSTREAM INCLUDING A  
MOTION VECTOR AND  
QUANTIZED DCT BLOCKS OF  
RESIDUALS FOR EACH  
ENCODED MACROBLOCK

FOR A QUARTET OF  
MACROBLOCKS, COMPARE  
MAGNITUDES OF THE  
CORRESPONDING DCT  
BLOCKS OF RESIDUALS

ESTIMATE A MOTION  
VECTOR FOR A  
MACROBLOCK RESULTING  
FROM DOWNSAMPLING  
THE QUARTET USING THE  
MOTION VECTOR  
CORRESPONDING TO THE  
SMALLEST MAGNITUDE

*FIG. 1a*

BITSTREAM WITH  
MACROBLOCK MOTION  
VECTORS AND DCTs

FIELD  
DCTs?

NO

YES

HORIZONTAL DOWNSAMPLE  
TOP AND BOTTOM FIELD  
DCTs SEPARATELY; AVERAGE  
DOWNSAMPLED DCTs

VERTICAL  
DOWNSAMPLE;  
THEN HORIZONTAL  
DOWNSAMPLE

MOTION VECTORS, ...

*FIG. 1b*

MOTION  
VECTOR REFINEMENT  
NEEDED?

NO

YES

MACROBLOCK  
ALIGNED WITH REFERENCE  
DCT BLOCKS?

NO

YES

SIX DCT BLOCK 16x18  
SEARCH WINDOW EXTENDED  
TO 18x18 BY PADDING; OR  
FOUR DCT BLOCK 16x16  
SEARCH WINDOW EXTENDED  
TO 18x18 BY PADDING

NINE DCT  
BLOCK 18x18  
SEARCH  
WINDOW

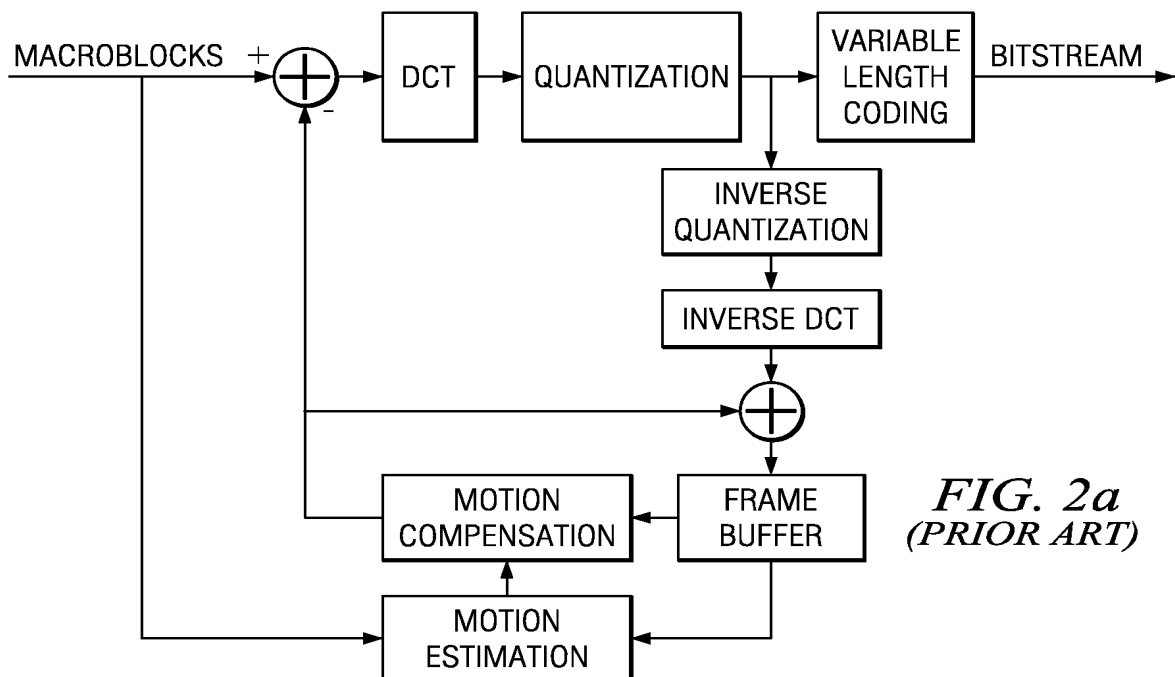
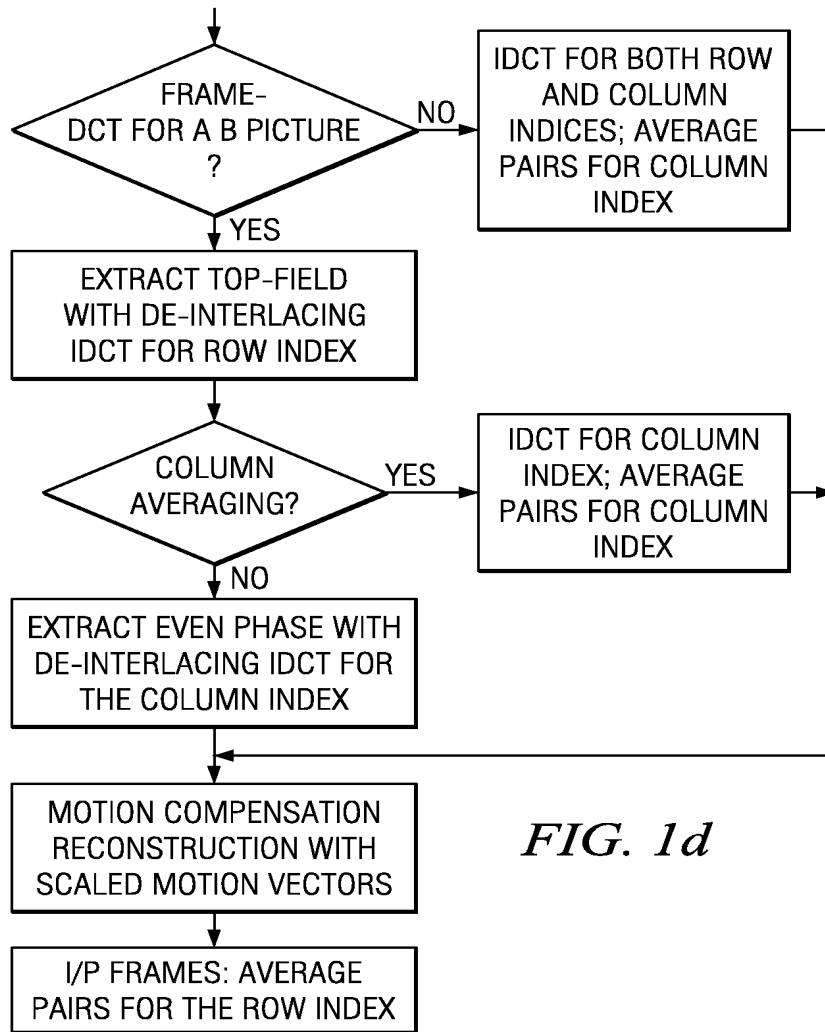
REFINE MOTION VECTOR

MOTION VECTOR OUTPUT

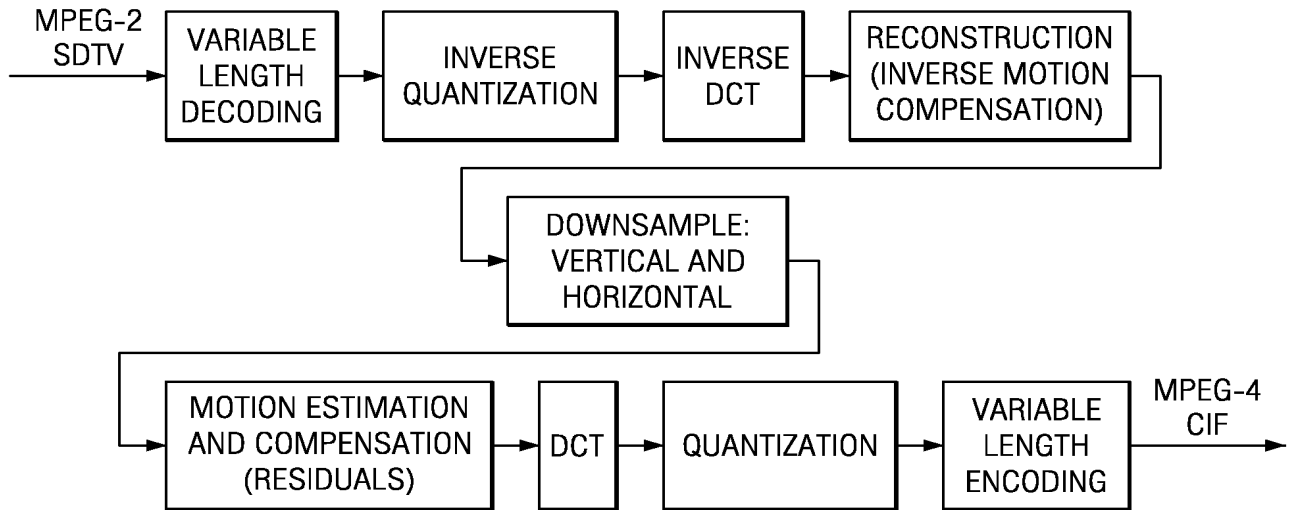
*FIG. 1c*

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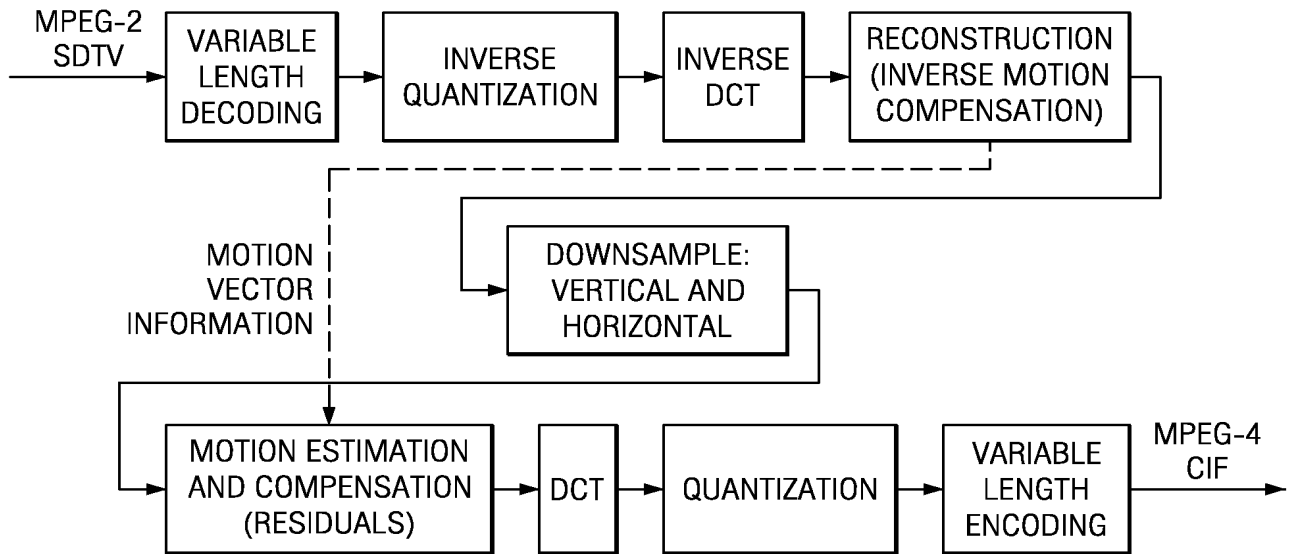
BITSTREAM WITH MPEG-2 MOTION  
VECTORS AND FRAME-DCTs



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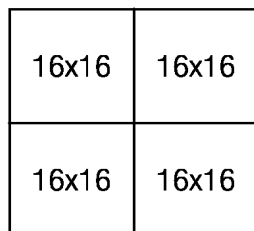


**FIG. 2b**  
(PRIOR ART)



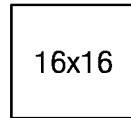
**FIG. 3a**

QUARTET OF MPEG-2  
MACROBLOCKS

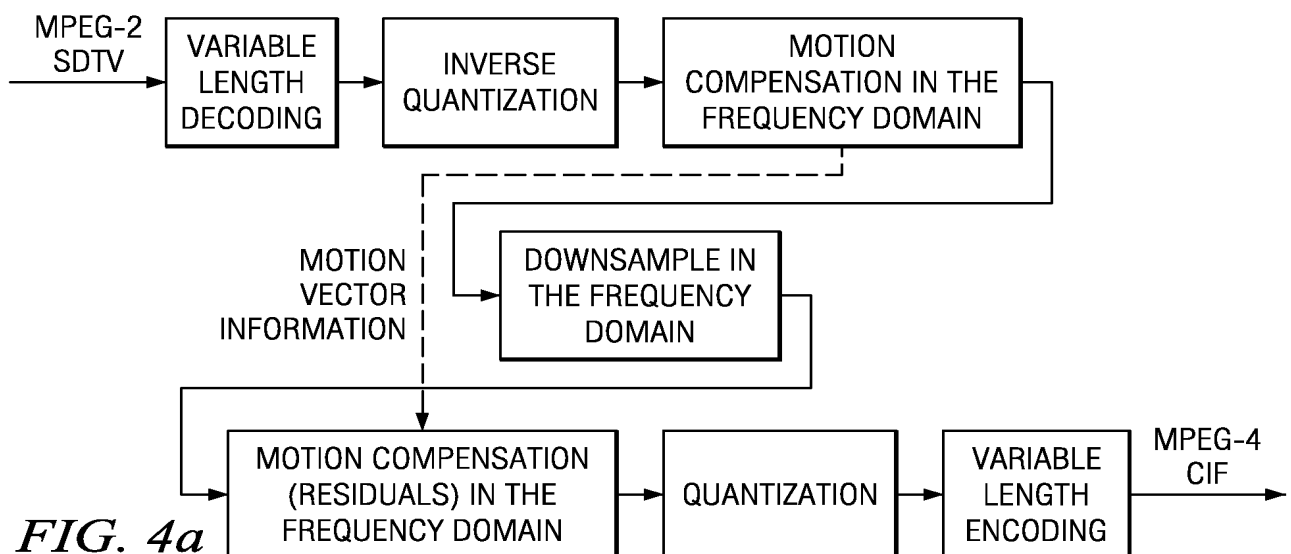
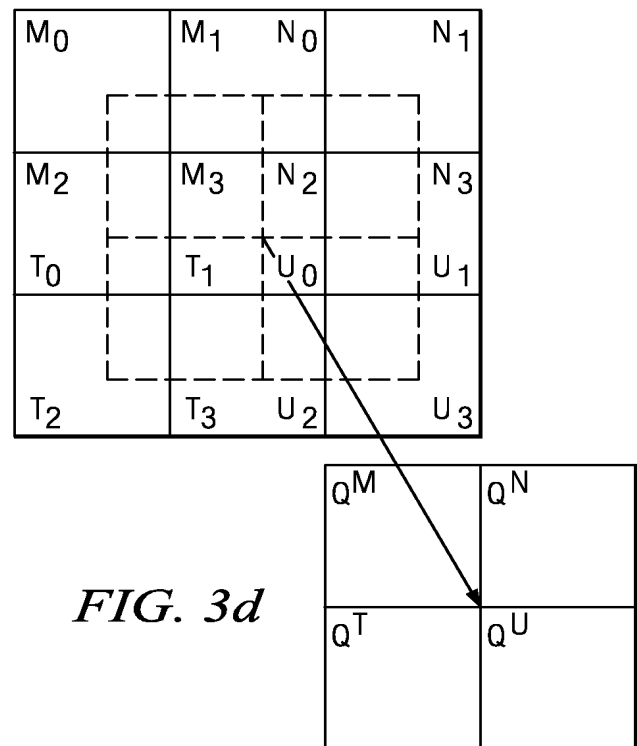
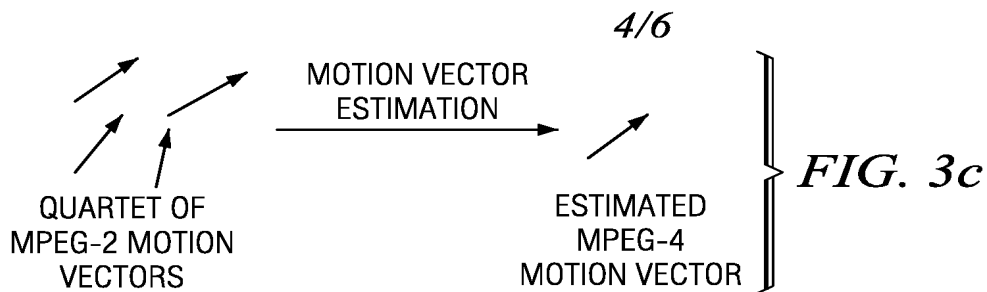


DOWNSAMPLE

MPEG-4  
MACROBLOCK



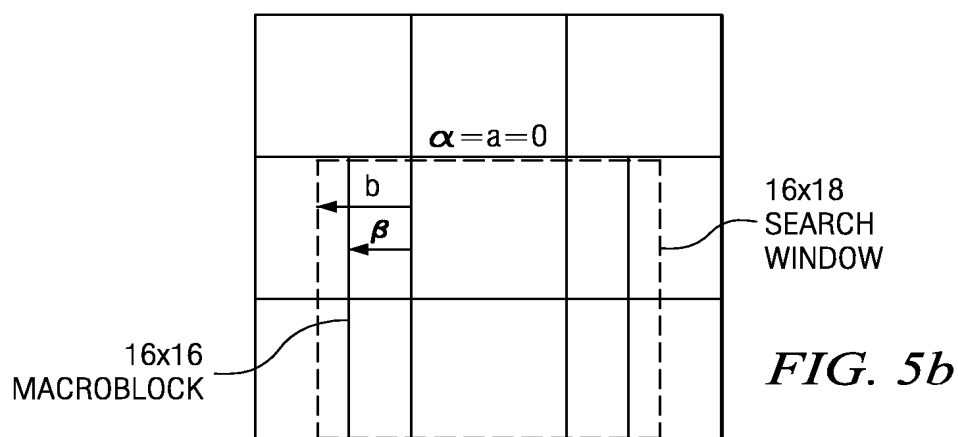
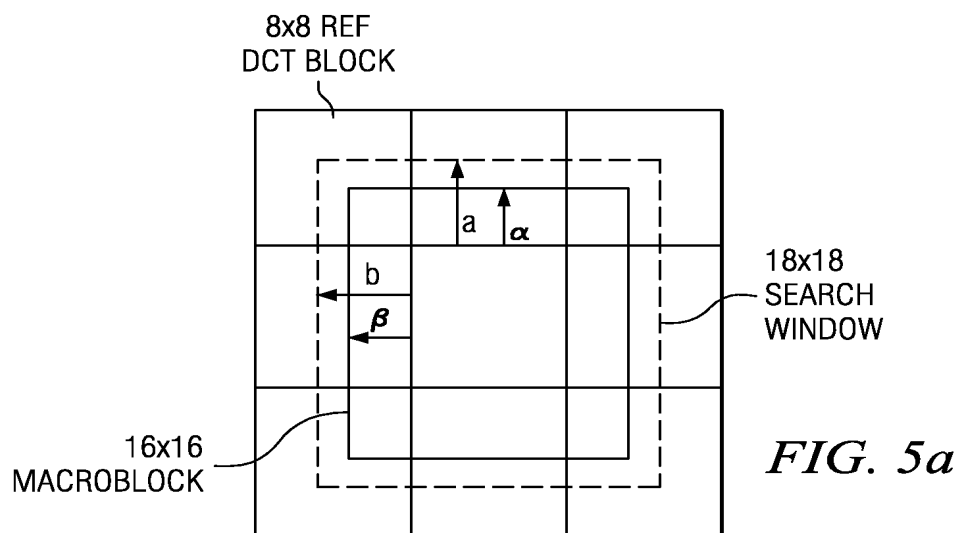
**FIG. 3b**



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graph LR
    A[MPEG-2 SDTV] --> B[VARIABLE LENGTH DECODING]
    B --> C[INVERSE QUANTIZATION]
    C --> D[DOWNSAMPLE IN THE FREQUENCY DOMAIN]
    D --> E[INVERSE MOTION COMPENSATION IN THE FREQUENCY DOMAIN]
    E --> F[MOTION COMPENSATION (RESIDUALS) IN THE FREQUENCY DOMAIN]
    E -.->|MOTION VECTOR INFORMATION| F
    F --> G[QUANTIZATION]
    G --> H[VARIABLE LENGTH ENCODING]
    H --> I[MPEG-4 CIF]
  
```

**FIG. 4b**



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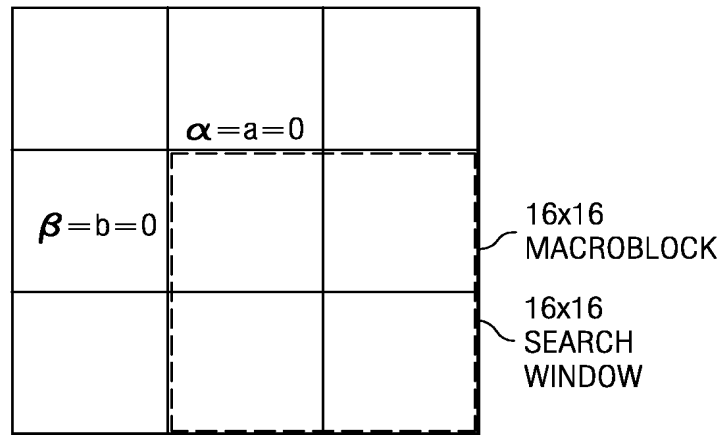


FIG. 5c

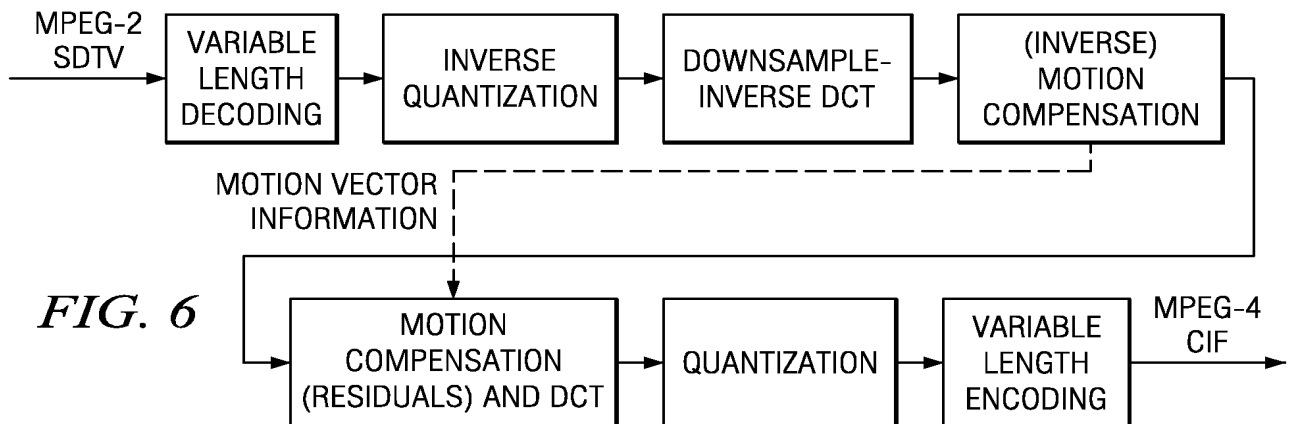


FIG. 6